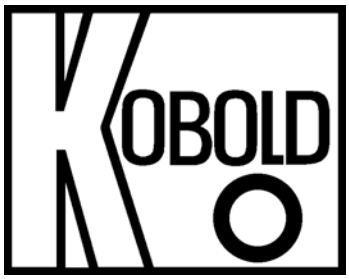
Operating Instructions
for
Compact Calorimetric
Flow Monitor

Model: KAL-D



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2. Note

Please read these operating instructions before unpacking and putting the unit into operation. Follow the instructions precisely as described herein.
The devices are only to be used, maintained and serviced by persons familiar with these operating instructions and in accordance with local regulations applying to Health & Safety and prevention of accidents.

By usage in machines, the measuring unit should be used only when the machines fulfil the EWG-machine guidelines.

3. Regulation use

This device must be installed, operated and maintained per these installation instructions. Any damages resulting from mis-use or mis-application are not the responsibility of the manufacturer. The user assumes all risk for such usage. The application specifications include the installation, start-up and service requirements specified by the manufacturer.

The model KAL-D flow monitor is used to monitor the flow of liquids.

Limit value / output

To monitor the velocity of liquids in pipes, the device is fitted with a PNP switch (NPN optionally available).

Trend indicator

The actual flow value is indicated by a series of constantly illuminated LEDs on the LED bargraph display. The current switchpoint is indicated on the LED bargraph by the individually blinking LED.

Sensor

The model KAL-D flow monitor consists of a sensor with an electronic measuring circuit. The KAL-D is in an electronic housing which meets IP 65/NEMA 4X protection requirements when properly installed. The sensor is designed for minimal pressure loss when operating.

Material

Sensor	Stainless steel 316L/1.4404
Electronics housing	Stainless steel 304/1.4301

Measuring and switching ranges

These figures are based on nominal pipe size (NPS).

NPS (mm)	Approximate measuring range (l/min) water	NPS (mm)	Approximate measuring range (l/min) water
8	0.12 - 6.0	40	3.0 - 150
10	0.19 - 9.4	50	4.7 - 235
15	0.42 - 21.2	60	6.8 - 340
20	0.75 - 37.7	80	12.0 - 603
25	1.18 - 59.0	100	18.8 - 942
30	1.70 - 84.8	150	42.4 - 2120

Caution! In determining the specified measuring ranges the flow velocities were based on nominal pipe sizes. However, please note that depending on the nominal pipe size, the sensor installation depth and the flow profile, there may be some significant deviations from these indicated flow values and those in the actual installation.

4. Operating Principle

Theory of operation:
The operation of the model KAL-D electronic flow monitor is based on the calorimetric principle. The sensor tip is heated to a few degrees above the temperature of the flowing liquid. When the liquid is flowing, the heat generated in the sensor is transferred to the liquid, i.e. the sensor is cooled. The cooling time is an accurate measure of the flow speed. The sensor signal is compared with the reference data (setpoint) stored in a micro-controller. If the actual flow speed is less than the setpoint flow speed, the output switches. The micro-controller in the flow monitor allows easy calibration and ideal temperature compensation to account for variations in liquid temperature.

5. Instrument Inspection

Instruments are checked before dispatch and should arrive in perfect condition.
In case of damage, please inform your local Kobold office or if you had the parcel delivered by a parcel service, contact your parcel service / forwarding agent immediately, since they are responsible for damages during transit. Should the damage to a device be visible, we recommend a thorough inspection of the delivery packing.

Scope of delivery:

- Flow Monitor, Model KAL-D
- Operating Instructions

6. Mechanical connection

Before installation

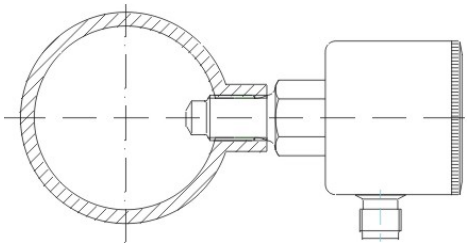
- Make sure that the actual flow speed corresponds to the switching range of the device.
- Make sure that the maximum process pressures and service temperatures specified for the device will not be exceeded.
  (See “Technical details”)

Installation

Mount the sensor in the pipe and ensure that the tip is covered by the liquid to be monitored. The sensor tip must extend at least 5 mm (better > 5 mm) into the pipe (see below).

Mounting position

The sensor can be mounted in any position, provided that the pipe is completely filled with the liquid to be monitored. The installation position must be free of swirling and turbulence (the recommended inlet and outlet pipe runs 5x the diameter of the pipe with straight pipe sections immediately upstream and downstream of the sensor). If it is expected that the liquid will leave deposits in the piping, the following mounting position is recommended (see figure below).

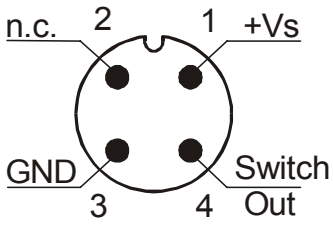


7. Electrical connection

Caution! Make sure that the electrical supply lines are de-energized when connecting the device!
Make sure that the supply voltage of your system is the same as that specified on the device nameplate.

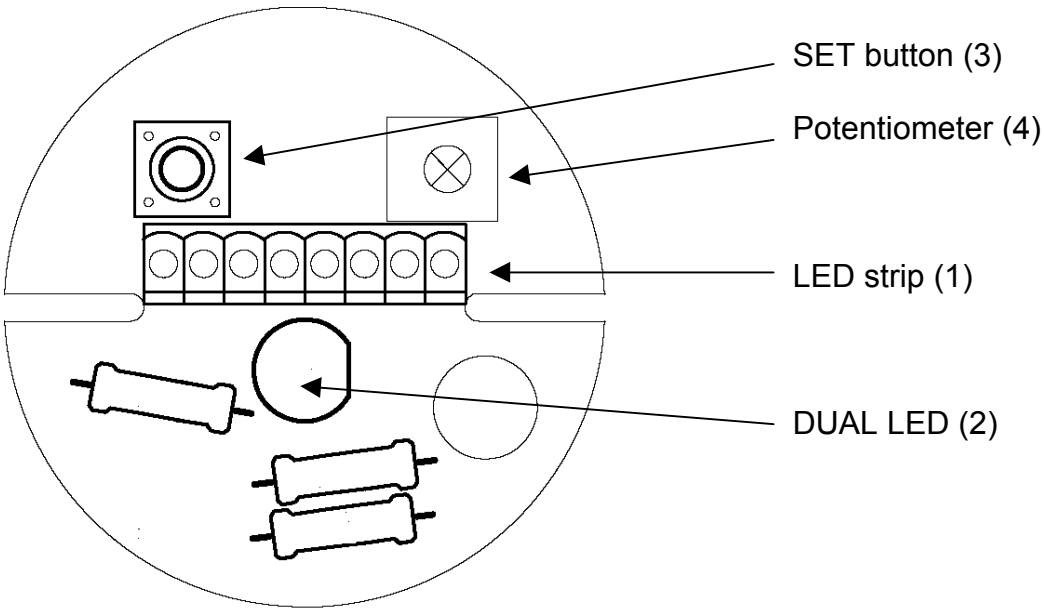
- Connect the KAL-D according to following wiring diagram.
- Switch on the operating voltage (24 V_{DC} ± 10 %) (see "Technical details").
- Check the electronics for proper function (the switching-point LED must be blinking).
- Adjust the setting of the flow monitor (see "Putting in operation").

Pin 1	+Vs / 24V_{DC}
Pin 2	n.c.
Pin 3	GND / 0V_{DC}
Pin 4	Switch out



8. Function elements

(View with cover removed)



LED strip display (1)

The strip of LEDs (8 segments) displays the flow value:

- The flow value is shown on the strip of LEDs, starting at the left.

The blinking LED displays the switching point:

- When flow is at the flow setpoint, the switching-point LED starts to blink more rapidly.

DUAL LED (2)

The DUAL LED display indicates the following:

- The switching point:
  Red = ALARM (actual flow below setpoint))
  Green = FLOW (actual flow above setpoint)

  In the standard operating mode, the DUAL LED is constantly illuminated

- Setup mode display
  If an adjustment (zero or span) is being performed, the DUAL LED blinks green.
- Error message display
  In the event of an error message, the DUAL LED blinks red.

SET button (3)

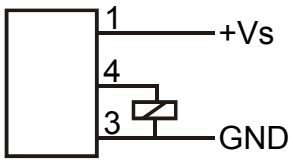
Press the SET button to start the adjustment (zero or span) procedure.

Potentiometer for setting the switching point (4)

The potentiometer is used to set the switching point. Depending on the potentiometer setting, the location of the blinking LED on the LED strip will change. The potentiometer is also used during the setup mode.

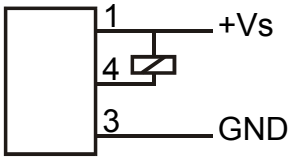
9. Type of output

PNP output (type of contact: (N/O or N/C)



The PNP semiconductor output either outputs +24 V_{DC} or is high-resistance (open circuit).
The maximum output current is 400 mA.
The reference point of the PNP output is GND (GROUND = 0 V_{DC})

NPN output (type of contact: N/O or N/C)



The NPN semiconductor output either grounds the output pin (GROUND = 0 V_{DC}) or is high-resistance (open circuit).
The maximum output current is 400 mA.
The reference point of the NPN output is +24 V_{DC}.

9.1. Output function

Normally Open (N/O) contact (type of contact: NPN or PNP)

The N/O contact switches the output to the low-resistance state ("switch" closed) whenever the flow is above the switching point.
The N/O contact switches the output to the high-resistance state ("switch" open) whenever flow is below the switching point.

	PNP	NPN	DUAL LED
actual flow > setpoint	"switch" closed	"switch" closed	green
actual flow < setpoint	"switch" open	"switch" open	red
power supply failure	"switch" open	"switch" open	off

Since the N/C switch function will go to an alarm (open switch) state on a loss of power, it is the preferred switch logic when a failsafe or loss of power is desired.

Normally Closed (N/C) contact (type of contact: NPN or PNP)

The N/C contact switches the output to the low-resistance state ("switch" closed) whenever the flow is below the switching point.
The N/C contact switches the output to the high-resistance state ("switch" open) whenever the flow is above the switching point.

	PNP	NPN	DUAL LED
actual flow > setpoint	"switch" open	"switch" open	green
actual flow < setpoint	"switch" closed	"switch" closed	red
power supply failure	"switch" closed	"switch" closed	off

10. Operation

When used in machinery in accordance with EU Directive 89/392/EEC, this device may not be placed in operation until it has been determined that the machine in use complies with this directive.
First install the sensor (complete the "Mechanical connection"), then connect the electrical lines (complete the "Electrical connection"). After these steps are completed, the zero, span and setpoint adjustments may be made.

To make the settings on the flow monitor, unscrew the cover to access the controls.

Adjustment

a) No-flow (zero) adjustment
To set the no-flow adjustment, proceed as follows:

- Stop the flow of the liquid in the piping in which the sensor is installed. It is important that the pipe is filled with liquid and the sensor tip be immersed in the liquid. There should be no bubbles around the sensor tip.
- Rotate the potentiometer (4) counterclockwise as far as it will go (to the left-hand stop).
- Now press the SET button. The DUAL LED blinks green.
- Do not make any changes (potentiometer setting, etc.) while the DUAL LED is blinking. This adjustment phase will last approx. 5-15 sec.
- When the DUAL LED stops blinking, the zero adjustment is set. The device now switches automatically to the monitoring mode. The display must indicate no flow. The LED strip should not be illuminated; only the first LED in the strip should be blinking.
- The flow monitor is now ready for operation.

b) Measuring range (span) adjustment
To set the measuring range, proceed as follows:

The flow monitor is set at the factory for the greatest possible range of flow speed (2 m/s). At lower flow speeds, not all 8 LEDs will illuminate. To achieve finer monitoring resolution, the measuring range can be adjusted to better fit the actual flow speed.

- Rotate the potentiometer clockwise as far as it will go (to the right-hand stop). The extreme right-hand LED in the LED strip will blink. Set the desired maximum system flowrate.
- Now press the SET button. The DUAL LED blinks green.
- Do not make any changes (potentiometer setting, etc.) while the DUAL LED is blinking. This adjustment phase will last approx. 5-15 sec.
- The span adjustment procedure is now complete. The device now switches automatically to the monitoring mode. This adjustment has set the device

measuring range so that it now extends across the entire LED strip at the maximum system flow.
- The adjustment procedure is now complete. It may be repeated as often as necessary.

c) Measuring mode
After adjustment, the flow monitor is once again in measuring mode.
The flow is constantly monitored and the actual value of the flow speed is displayed on the LED strip.

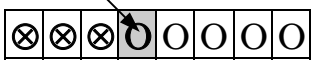
Switching point setting
The potentiometer is now used to set the switching point (threshold) of the flow switch. The switching point is displayed as a blinking LED. If the extent of the illuminated LED light strip (actual flow value) reaches the position of the blinking LED, the flow monitor switches over from ALARM to FLOW. This can be seen at the display: the DUAL LED that was showing a steady red light now switches to a steady green light. The output is also switched at the same time.

Slowly blinking
switching point LED (setpoint) — **actual flow < setpoint (no flow)**

Alarm status

⊗ DUAL LED illuminated red — no LEDs lit = no flow

Slowly blinking
switching point LED (setpoint) — **actual flow < flow below set-point**

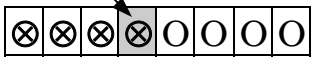


Alarm status

light strip actual value — Actual flow below setpoint

⊗ DUAL LED illuminated red

Quickly blinking
switching point LED (setpoint) — **actual flow = setpoint**

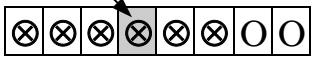


output switches

light strip actual value

⊗ DUAL LED illuminated green — Actual flow has just reached setpoint

Slowly blinking
switching point LED (setpoint) — **actual flow> setpoint**



Flow status (ideal conditions)

light strip actual value — This is the most desirable status.

⊗ DUAL LED illuminated green

After the settings are completed, screw the cover tightly back on the housing (make sure that the window for viewing the LED strip is aligned with the strip.).

11. Error Messages

The sensor element itself is monitored for short circuits, open circuits and electronics failure. Should a fault occur, this will be indicated by a red blinking light at the DUAL LED and the LED strip display. In this event, contact the KOBOLD service department.

12. Technical Data

Power supply:	24 V_{DC} ±10%
Power consumption:	max. 3.6 W
Ambient temperature:	-20 °C to +60 °C
Liquid temperature:	-20 °C to +80 °C
CIP compatible:	max. 140 °C without function
Max. pressure:	40 bar
Time delay before availability:	max. 12 s
Switching range:	approx. 0.04 m/s to 2 m/s
Temperature gradient:	Unlimited
Response time:	5.6 to 12 s, typical
Flow indication:	Trend indication with 8-position LED strip display
Switching point setting:	With potentiometer, optical indicator on LED strip display (blinking LED)
Output status indicator:	1 dual LED
Switching output:	Semiconductor, PNP or NPN, max. 400 mA, short-circuit-proof, N/O or N/C contact, set at the factory
Electrical connection:	M12 x 1 plug connector
Protection type:	IP 65
Housing material:	Housing: stainless steel 1.4301 Housing cover: stainless steel 1.4301
Process connection:	G 1/4, G 1/2, 1/4 NPT, 1/2 NPT M12 x 1, stainless steel 1.4404

13. Order Codes

Example: KAL-D1408 N ST3

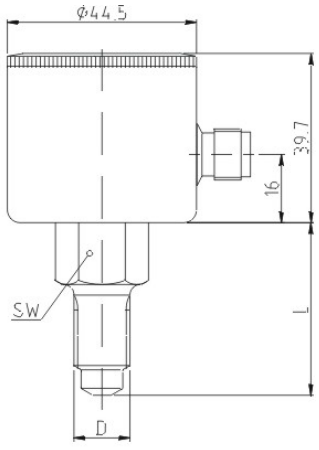
Connection	Model	Type of contact	Electrical connection
G 1/4	**KAL-D1408**	**..N**=NPN/N/O contact	**ST3=** plug connector M 12x1; 24 V_{DC}
G 1/2	**KAL-D1415**	**..P**=PNP/N/O contact	
1/4 NPT	**KAL-D5408**	**..M**=NPN/N/C	
1/2 NPT	**KAL-D5415**	**..R**=PNP/N/C	
M 12x1	**KAL-D0412**		

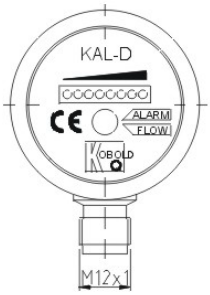
14. Maintenance

This device is maintenance-free. The sensor tip should be checked for the presence of mineral deposits (lime, etc.) and cleaned if necessary.

15. Dimensions

Fitting size	Length mm	Wrench size mm
M 12x1	40.5	19
G 1/4	40.5	19
1/4 NPT	40.5	19
G 1/2	40.5	27
1/2 NPT	40.5	27





16. Declaration of Conformance

We, Kobold Messring GmbH, Hofheim-Ts, Germany, declare under our sole responsibility that the product:

Compact Calorimetric Flow Monitor Model: KAL-D

to which this declaration relates is in conformity with the standards noted below:

EN 50081-2 1994-03
Generic emission standard

EN 61000-6-2-2 2000-03
Generic immunity standard

Also the following EWG guidelines are fulfilled:

89/336 EWG Electromagnetic compatibility

Signed: date: 29.06.02

H. Peters M. Wenzel